WAREHAM RIVER BASIN
WAREHAM, MASSACHUSETTS

HARLOW BROOK NO. 1 DAM
MA 00032

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

APRIL 1979

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Harlow Brook Dam No.1 is a 200-foot long, 12-foot high earthfill dam. The dam is in poor condition. The dam has been placed in the "low" hazard category. An outflow test flood (estimated as ½ of the PMF) of 265 cfs will overtop the dam to El 50.1. The conduit stoplogs can discharge 28% of the test flood before the dam is overtopped.

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HARLOW BROOK NO. 1 Dam

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PHASE I INSPECTION REPORT
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PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00032

Name of Dam: Harlow Brook No. 1

Town: Wareham

County and State: Plymouth County, Massachusetts

Stream: Harlow Brook

Date of Inspection: December 11, 1978

Harlow Brook Dam No. 1 is a 200-foot long, 12-foot high earthfill dam built in 1910. The crest of the dam is used as a roadway to a picnic area on the west side of the reservoir. Discharge from the dam is through a 5.1-foot wide by 10-foot high arched concrete conduit. Flow through the conduit is controlled by manually removed stoplogs with the top at elevation (El) 45.9. Discharge from the conduit is directly into the reservoir of Harlow Brook No. 2.

There are deficiencies which must be corrected to assure the continued performance of this dam. This conclusion is based upon the visual inspection at the site, the available engineering data, and limited evidence of operational and maintenance procedures. Generally, the dam is in poor condition. According to the Corps of Engineers guidelines for the classification of hazard potential, the dam has been placed in the "low" hazard category.

The following are visible signs of distress which indicate a potential hazard at the site: seepage at the dam, spalling and undermining of the walls in the discharge conduit, missing riprap on the downstream face of the dam, erosion of the downstream slopes and accumulation of debris in the discharge channel.

Hydraulic analyses indicate that the conduit with stoplogs in place can discharge a flow of 75 cfs with

the water surface at El 49.5, which is the average low point on the crest of the dam. Therefore, an outflow test flood (estimated as one-fourth of the PMF) of ~~265~~ cfs will overtop the dam to El 50.1. The conduit "with" stoplogs can discharge 28 percent of the test flood before the dam is overtopped.

Because of the low hazard potential at this dam, additional investigations to assess the adequacy of the spillway and embankment are not considered necessary at this time. However, until the recommended remedial measures are accomplished, the Owner is advised to remove the stoplogs in the outlet and lower the reservoir.

It is recommended that the Owner accomplish the following: repair the concrete walls in the conduit, replace the missing riprap, repair the undermined sections of the conduit wall, repair the erosion of the slopes and remove the debris from the discharge channel. The Owner should also implement a regular program of inspection and maintenance.

The recommendations and remedial measures outlined above and in Section 7 should be implemented by the Owner within a one year period after receipt of this Phase I Inspection Report. An alternative to these recommendations would be to remove the stoplogs and drain the pond.

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This Phase I Inspection Report on Harlow Brook No. 1 has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVENS, JR., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

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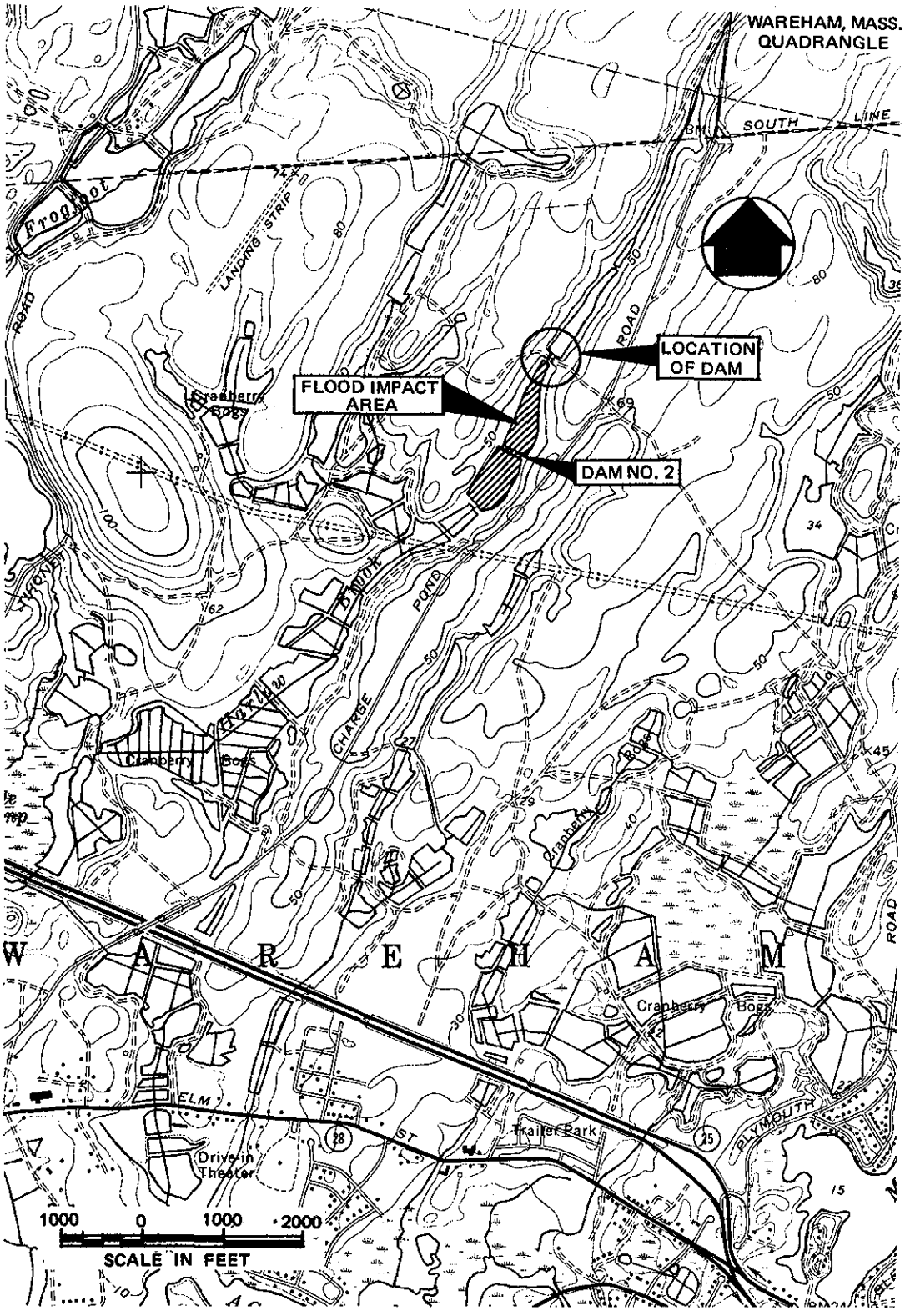
WAREHAM, MASSACHUSETTS



LOCATION MAP – HARLOW BROOK DAM NO. 1

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

HARLOW BROOK NO. 1 RESERVOIR

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Divison of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-79-C-0016, dated November 28, 1978, has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The reservoir is located on Harlow Brook in the Town of Wareham, Plymouth County, Massachusetts (see Location Map and Figure D-1 Drainage Area Map).

b. Description of Dam and Appurtenances. Harlow Brook Dam No. 1 is an earthfill dam 200 feet long and 12 feet high (see Figure B-1). The crest of the dam is 35 to 40 feet wide and is used as an access road to a picnic area on the west side of the pond. The elevation of the crest varies from 49.2 to 52.6. Both abutments tie into natural ground. The upstream slope, which is generally covered with riprap, has a slope of approximately 1.5:1. The upper part of the downstream slope is grass covered and has a slope of 2:1 extending to a stone wall varying in height from 2 to 3.5 feet at a 1:2 slope (horizontal to vertical).

Discharge from the dam is through an outlet structure located near the center of the dam. This structure is a concrete arched conduit, 5.1 feet wide including 8 inch wide curbs by 10 feet high. The conduit is 41 feet long.

The approach to the outlet structure is a 5.1-foot wide opening with reinforced concrete walls and a rockfill bottom. The walls only extend to the toe of the slope. Stoplogs at the entrance to the conduit were set at El (elevation) 45.9. The conduit invert at the base of the stoplogs is at El 36.1. The discharge from the outlet of the conduit is to a 5.1-foot wide stone-paved channel that extends to the toe of the downstream slope.

c. Size Classification. Harlow Brook Dam No. 1 is classified in the "small" category, since it has a maximum height of 12 feet and a maximum storage capacity of 26 acre-feet.

The Massachusetts Department of Public Works District No. 7 inspection reports dated August, 1973 and December, 1975 state the volume of reservoir is 50,000,000 gallons (153 acre-feet). We could not verify or explain this number. Our calculations indicate that the reservoir surface area is 4 acres and the storage is 26 acre-feet.

d. Hazard Classification. Immediately downstream of the dam is the reservoir for Harlow Brook

Dam No. 2. Below Dam No. 2 are cranberry bogs. These bogs extend from the toe of the dam to Route 25, a distance of 6,500 feet. Route 25 in this area is a high embankment highway. In the event of complete failure of the dam, it is unlikely that extensive property damage would occur or than any lives would be lost. Accordingly, the dam is placed in the "low" hazard category.

e. Ownership. At the present time, the ownership of this property is in litigation and is in doubt. The holding company is the Empire National Bank, New City, New York (Telephone: 914-634-6300). Local counsel for the company is Mr. Jasse, Esq., Brown, Rudnick, Freed & Gesmer, 85 Devonshire Street, Boston, Massachusetts 02114 (Telephone: 617-737-7800).

f. Operators. There are no known operators of this dam.

g. Purpose of Dam. Water is stored in the pond for irrigation of the cranberry bogs downstream of the No. 2 Dam. Mr. Daniel O'Connor of Great Neck, Massachusetts is the owner of the cranberry bogs downstream of Dam No. 2. He reportedly has permission to remove the stoplogs; however, he has never had to do so in order to irrigate his crop. The pond upstream of Dam No. 1 is used for recreational purposes such as fishing and swimming.

h. Design and Construction History. Reports of previous inspections of this dam indicate that the dam was constructed in 1910. No records of construction were found. Between 1973 and 1975, the slopes of the dam were flattened, riprap was added on the downstream side and a rock fill was placed along the toe and slope of the upstream embankment. These repairs were recommended in the 1973 dam inspection report made by the Massachusetts Department of Public Works. Recommendations for repair work to the outlet conduit were also made at that time but were not carried out by the owner.

i. Normal Operating Procedures. Under normal conditions, the stoplogs are maintained at El 45.9. Water flows over the stoplogs into

Harlow Brook Reservoir No. 2. This water is used for irrigation of cranberry bogs downstream from the dam for Harlow Brook Reservoir No. 2.

1.3 Pertinent Data

a. Drainage Area. The drainage area is approximately 680 acres (1.06 square mile) and includes Charge Pond located about 1.5 miles north of the dam, on Harlow Brook. The drainage area is sparsely developed, generally wooded and relatively flat.

b. Discharge. Normal discharge is over the stoplogs. The stoplogs are 5.1 feet wide and the outlet conduit is 5.1 feet wide. The conduit is 41 feet long. The stoplogs are set at El 45.9. Flow through the discharge conduit is into a lower pond. Harlow Brook Dam No. 2, located downstream, has stoplogs which are set at El 39.7. The discharge conduit at Harlow Brook Dam No. 1 can discharge an estimated 75 cfs with the water surface at El 49.5 which is the average low point on the crest of the dam. The outflow test flood (estimated one-fourth PMF) of 250 cfs at El 50.1 will overtop the dam.

The maximum flood level at the dam in unknown.

c. Elevation (feet above Mean Sea Level (MSL)). A benchmark was established at El 50.0 at the side wall of the approach channel. This elevation was estimated from the USGS topographical sheet. Due to the lack of construction drawings, this elevation was assumed for the purpose of the survey.

(1) Top dam: 52.2 to 49.2

(2) Test flood pool: 50.1

(3) Design surcharge: Unknown

(4) Full flood control pool: Not Applicable (N/A)

(5) Recreation pool: 45.9

(6) Spillway crest (ungated): 45.9

(7) Upstream portal invert diversion tunnel: N/A

(8) Stream bed at centerline of dam: 36.1

(9) Maximum tailwater: 39.0

d. Reservoir

(1) Length of maximum pool: 1,700 feet

(2) Length of recreation pool: 1,700 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge (net): 17 at El 50.1

(2) Top of dam: 26

(3) Flood control pool: N/A

(4) Recreation pool: 11

(5) Spillway crest: 11

f. Reservoir Surface (acres)

*(1) Top dam: 4

*(2) Test flood pool: 4

(3) Flood-control pool: N/A

(4) Recreation pool: 4

(5) Spillway crest: 4

*Based on the assumption that the surface area will not increase significantly with changes in reservoir elevation from 46.0 to 50.1.

g. Dam

(1) Type: earthfill

(2) Length: 200 feet

(3) Height: 12 feet

(4) Top width: varies from 35 to 40 feet

(5) Side slopes: upstream = 1.5:1
downstream - upper two-thirds - 2:1 (earth)
lower one-third - 1:2 (stone wall)

(6) Zoning: Unknown

(7) Impervious core: Unknown

(8) Cutoff: Unknown

(9) Grout curtain: Unknown

i. Spillway. (No spillway at this site, other than outlet conduit.)

(1) Type: sharpcrested weir - stoplogs

(2) Length of weir: 5.1

(3) Crest elevation: 45.9 (top of stoplogs)

(4) Gates: None

(5) Upstream channel: soil and stone

(6) Downstream channel: paved stone to Harlow Brook No. 2 Reservoir

j. Regulating Outlets. The regulating outlet at the dam is a 5.1 foot wide by 10 foot high arched concrete conduit. Manually installed stoplogs are used to control the flow.

SECTION 2

ENGINEERING DATA

2.1 General. There are three Inspection Reports - titled "Dams and Reservoirs" dated September, 1973, October, 1975, and February, 1978, which were prepared by the Massachusetts Department of Public Works District No. 7 in Middleboro, Massachusetts. There is also one Inspection Report of the dam dated September, 1937, and updated periodically through October, 1969, which was prepared by the Plymouth County Engineering Department. This file is available at the Plymouth County Commissioner's Office in Plymouth, Massachusetts.

We acknowledge the assistance and cooperation of the personnel of the Department of Public Works District No. 7: Mr. Richard Slade, in Middleboro, Massachusetts; and the Plymouth County Engineering Department. Also, Mr. O'Connor, the owner of the downstream cranberry bogs, for his information on the operation of the dam.

2.2 Construction Records. There are no construction records available.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

2.4 Evaluation

a. Availability. There is no engineering data available. The DPW inspection reports provide the only record of repairs at the site.

b. Adequacy. The lack of hydraulic, structural and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on review of available drawings, visual inspection, and engineering judgment.

c. Validity. Comparison of the available inspection reports with the field survey conducted during the Phase I inspection indicates that the available information is valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam at Harlow Brook was performed on December 11, 1978. A copy of the inspection checklist is included in Appendix A. Previous inspections of this dam have been made from 1937 through 1969 by the Plymouth County Engineer's Office. A listing of these inspections is included in Appendix B. Inspection reports by the Massachusetts Department of Public Works, dated 1973, 1975 and 1978, are also included in Appendix B.

b. Dam. Harlow Brook Dam No. 1 is an earthfill dam with an outlet structure through the center of the embankment. Seepage through and under the dam has formed a small pool at the toe about 30 feet west of the discharge channel. The water in this pool is colored orange. A hole was observed at the toe of the dam about 45 feet east of the discharge channel. This area was wet. The hole was circular but could only be probed to a depth of 1 foot. The hole was possibly caused by seepage under the dam or is an abandoned outlet pipe. Seepage from this hole has eroded a small gully 3 to 6 inches deep.

The upstream slope is covered with riprap. The stones range in size from 6 to 18 inches. The slope and riprap are both in good condition. A stone wall protects the bottom third of the downstream slope from the discharge water which is immediately ponded by Harlow Brook Dam No. 2. The wall consists of stones 6 to 30 inches in size. Stones are missing in the vicinity of the discharge conduit. The upper two-thirds of this slope is protected by vegetation. This vegetation is growing close together and bare soil is exposed. Surface runoff has cut gullies 2 to 4 inches deep in the slope. This slope is in fair condition. Vehicular traffic

across the dam has destroyed all vegetation on the crest. Ruts in the roadway are 4 to 6 inches deep. The embankments and crest are generally in fair condition.

c. Appurtenant Structures. The outlet structure is a 41-foot long arched concrete conduit that is located 30 feet west of the center of the dam. The conduit is in poor condition. The approach channel to this structure has concrete side walls extending to the bottom of the slope and a bottom lined with rock. Wooden stoplogs extend from El 45.9 down to El 36.0. There is leakage between the stoplogs. This section of the outlet structure is in good condition.

The conduit has severe spalling on the west wall (see Photograph No. 4). The reinforcing steel within the wall is exposed and corroding. The spalled area is triangular in shape and covers 8.5 square feet. This area was wet and dripping at the time of the inpsection. The water is apparently coming through the concrete wall. An 8-inch wide curb runs along both sides of the conduit at the base of the walls. The bottom of the conduit is concrete. The curb is undermined about 1 foot in the vicinity of the spalled area. A 10-foot section of the curb is missing on the east side of the conduit.

Side walls of the discharge channel show staining and spalling. The walls are undermined at the toe of the slope. The bottom of the channel is constructed of placed stone and is cluttered with debris. Some of the stone has been dislocated and is missing. The discharge channel is in fair to poor condition.

d. Reservoir Area. The area around Harlow Brook No. 1 is undeveloped. However, there is one beach for recreation and picnic areas are on both sides of the reservoir. One picnic area is accessible by walking or driving over the dam. It is possible that future residential development could occur in the watershed area. The drainage area is woody

with open areas of sand. It is relatively flat with an average slope of 0.6 percent.

e. Downstream Channel. Discharge from Harlow Brook No. 1 enters the reservoir of Harlow Brook No. 2. This crest elevation of the crest of Dam No. 2 is at El 41.0+. Stoplogs, which control the elevation of this pond are set at El 39.7. Cranberry bogs are located downstream of Dam No. 2 and extend 1.5 miles to Route 25.

3.2 Evaluation. The above findings indicate that the dam is in poor condition, and there are several deficiencies which require attention. Recommended measures to improve these conditions are stated in Section 7.3.

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. Under normal conditions excess water overflows the stoplogs which are set at El 45.9. Flow is directly into Harlow Brook Reservoir No. 2. Discharge over the stoplogs at Reservoir No. 2 is into cranberry bogs. The owner of the cranberry bogs indicated that, if necessary, he could maintain the level of Reservoir No. 2 by removing stoplogs. Apparently, this has never been necessary.

4.2 Maintenance of Dam. The dam is not adequately maintained. All previous inspection reports noted that maintenance to the outlet conduit was required. This has not been accomplished. Some limited maintenance to the slopes has been completed, however, additional work is required, such as replacing riprap and repairing the eroded slopes.

4.3 Maintenance of Operating Facilities. The outlet conduit is not maintained and is in poor condition.

4.4 Description of Any Warning System in Effect. There is no warning system in effect at this dam.

4.5 Evaluation. There is no regular program of maintenance or warning system in effect at Harlow Brook Dam No. 1. This is an undesirable situation for, although the dam is presently considered to be of low hazard potential, possible future development in the area could alter the classification. A program of inspection and maintainence and a surveillance system should be implemented as recommended in Section 7.3.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. The drainage area of Harlow Brook includes Charge Pond and several kettle-type depressions in the glacial outwash overburden. The drainage area consists of about 680 acres (1.06 square miles). The dam is classified in the "small" size category. At the time of the inspection, the water level (El 46.0) was just over the stoplogs (El 45.9) about 4 feet below the top of the earthfill dam. The water at the toe of the dam is the pond formed by Harlow Brook No. 2. Discharge from Harlow Brook No. 1 is over stoplogs which are 5.1 feet long and 9.9 feet high. The discharge flows to the Harlow Brook No. 2 through a 41-foot long, 5.1-foot wide by 10-foot high arched concrete conduit with a stone bottom. There is no other known outlet at Dam No. 1.

b. Design Data. There are no hydraulic computations available for this dam. The maximum design flow is unknown.

c. Experience Data. Hydraulic records are not available for this dam.

d. Visual Observations. The upstream slope is riprapped and in good condition. The bottom third of the downstream slope is protected by a stone wall. Some of the stones are missing. The upper two-thirds is sloped at 2:1 (horizontal to vertical) and covered with vegetation. There is erosion due to surface runoff. This has made gullies 2 to 4 inches deep. The concrete walls at the intake to the discharge conduit are in good condition. The stoplogs are made of wood and there is leakage between the stoplogs. Then stoplogs extend from El 45.9 down to El 36.0. The discharge conduit is in poor condition. On the west wall

of the discharge conduit there is a spalled area. Also, the 8-inch wide curb is undermined in this area. The discharge channel of the outlet structure is cluttered with debris and some of the stone paving on the bottom is missing. The concrete walls lining the discharge channel are spalled and cracked. The end of these walls are undermined where stones are missing from the wall protecting the slope and the stone-lined bottom of the channel.

e. Test Flood Analysis. Harlow Brook No. 1 receives flow from 1.06 square mile of tributary drainage area which includes Charge Pond. This dam has been classified as a small dam of low hazard potential. According to the Corps of Engineers' guidelines, the 100-year frequency flood should be used for evaluation of the capacity of the spillway. The 100-year flood for this report has been estimated to be approximately one-quarter the Probable Maximum Flood (PMF).

The PMF rate was determined to be 1,050 cfs per square mile. This calculation is based on the average drainage area slope of 0.6 percent, the pond-plus-kettle hole area to drainage ratio of 7.1 percent and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December, 1977). The peak outflow rate for the drainage area is calculated by applying one-quarter of the PMF to the 1.06 square miles of tributary drainage. The total inflow test flood was calculated to be 280 cfs. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 265 cfs (250 cfs per square mile) with the water surface at El 50.1.

Hydraulic analyses indicate that the outlet, with the stoplogs at their present elevation, can discharge a maximum 75 cfs with the water surface at El 49.5, which is the average low point on the dam. This discharge is 28 percent of the outflow test flood. The maximum head on the crest during the peak outflow would be 0.9 feet with a discharge of 2.2 cfs per foot of width. Depth at critical flow would be 0.5 feet with a velocity of 4.1 feet per second.

f. Dam Failure Analysis. The discharge rate due to failure was calculated for the east (right) embankment of the dam. The peak discharge rate would be 3,300 cfs with a maximum water depth of 7.8 feet. The flow would raise the level of the downstream pond by about 4 feet if all storage was released by Harlow Brook No. 1. The flood would overflow and possibly breach the lower dam. The flow would then dissipate rapidly in the downstream ponds and cranberry bogs. At present, there are no buildings downstream that would be affected by failure flows. For these reasons, the dam has been classified in the "low" hazard category.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of Harlow Brook No. 1 is based on a review of previous inspection reports and the visual inspection conducted on December 11, 1978. As discussed in Section 3, Visual Inspection, the dam is in poor condition. There appears to be seepage under the dam in two areas. These two seepage areas were both noted in the September, 1973 dam inspection report by the Massachusetts Department of Public Works, and in the Plymouth County Engineering Department's file on this dam.

b. Design and Construction Data. The dam was built in 1910. No records or drawings of the original construction are available. There is no available information on the type, shear strength, or permeability of the soil or rock.

c. Operating Records. There is no instrumentation of any type in Harlow Brook No. 1, and no instrumentation was ever installed in this dam. The performance of the dam under prior loading can only be inferred by physical evidence at the site.

d. Post-Construction Changes. There are no as-built drawings of the Harlow Brook No. 1. However, previous inspection reports include a plan and cross section through the outlet conduit. In each subsequent inspection report, the sketch has been updated to show any repair work that has been done. The major change occurred between 1973 and 1975 when the slopes were flattened and rockfill was added to the upstream slope. A stone wall 2 to 3.5 feet high was added to the downstream slope.

e. Seismic Stability. The dam is located in Seismic Zone No. 2 and in accordance with Phase I "Recommended Guidelines" does not warrant seismic analyses at this time.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon a review of available reports, the visual inspection of the site and limited operational or maintenance information, there are deficiencies which must be corrected to assure the continued performance of this structure. Generally, the dam is considered to be in poor condition. Several signs of distress were observed at the site: seepage at the dam, erosion of the slopes from surface runoff, spalling of the concrete, missing riprap on the upstream face of the dam and debris in the downstream channel.

Hydraulic analyses indicate that the discharge conduit can discharge a flow of 75 cfs with the water surface at El 49.5. An outflow test flood of 265 cfs (estimated as one-quarter the PMF) will overtop the dam by a maximum of 0.9 feet at a localized low point on the crest of the dam. The discharge conduit with stoplogs can discharge 28 percent of the test flood.

b. Adequacy. The lack of detailed design and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of the dam is based primarily on the visual inspection, past performance and engineering judgment.

c. Urgency. The recommendation and remedial measures outlined below should be implemented by the Owner within one years after receipt of this Phase I Inspection Report.

d. Need for Additional Investigation. Additional investigations to further assess the adequacy of the dam are outlined below in Section 7.2 Recommendations.

7.2 Recommendations. The overall condition of the dam is poor, however, because of its small size and low hazard potential, further investigations to assess the adequacy of the dam are not considered necessary at this time. The necessary repair and maintenance procedures which are required to prevent further deterioration of the dam are outlined in Section 7.3 Remedial Measures

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The dam and discharge channel are not adequately maintained. It is recommended that the Owner temporarily remove the stoplogs at the outlet and lower the pond level until such time as the following remedial measures are accomplished.

(1) repair the concrete wall in the conduit

(2) repair spalled section of wall and fill in undermined areas in the conduit and discharge structure

(3) backfill and protect the eroded areas on the slopes of the dam

(4) replace missing riprap on the downstream face of the dam

(5) replace dislodged and missing stones in the discharge channel and remove debris

(6) implement a systematic program of maintenance inspections. As a minimum, the inspection program should consist of an annual periodic technical inspection of the dam and appurtenances, supplemented by additional inspections during and after severe storms. All repairs and maintenance should be undertaken in accordance with all applicable State regulations.

7.4 Alternatives. An alternative to implementing the recommendations and the maintenance procedures listed above would be to permanently remove the stoplogs. Such action may interfere with the irrigation operation at the cranberry bogs.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

HARLOW BROOK NO. 1

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT HARLOW BROOK DAM NO. 1

DATE 12 / 11 / 78

TIME 9:30 AM TO 1:30 PM

WEATHER SUNNY - 30°F

W.S. ELEV. 46.0* U.S. ____ DN.S.

* BASED ON ASSUMED BENCHMARK ELEVATION OF 50.0 SET ON TOP OF CONCRETE INTAKE STRUCTURE OF OUTLET WORKS.

PARTY:

1. RICHARD WEBER
2. MICHAEL GILBERT
3. SUSAN PIERCE
4. LYLE BRANAGAN
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	DAM	R. WEBER / M. GILBERT	
2.	DISCHARGE CONDUIT	L. BRANAGAN / M. GILBERT	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT HARLOW BROOK DAM NO. 1 DATE 12 / 11 / 79

PROJECT FEATURE DAM EMBANKMENT NAME MICHAEL GILBERT

DISCIPLINE GEOTECHNICAL NAME RICHARD WEBER

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT Crest Elevation	ASSUMED ELEVATION 50.0 SET ON TOP OF CONCRETE HEADWALL OF INTAKE STRUCTURE
Current Pool Elevation	46.0
Maximum Impoundment to Date	UNKNOWN
Surface Cracks	NONE VISIBLE
Pavement Condition	N. A.
Movement or Settlement of Crest	NONE
Lateral Movement	NONE
Vertical Alignment	NONE
Horizontal Alignment	NONE
Condition at Abutment and at Concrete Structures	ABUTMENTS - GOOD DISCHARGE CHANNEL - RIPRAP MISSING AND EROSION HAS UNDERMINED THE CONCRETE WALLS
Indications of Movement of Structural Items on Slopes	N. A.
Trespassing on Slopes	UNPAVED ROAD OVER CREST
Sloughing or Erosion of Slopes or Abutments	DOWNSTREAM SLOPE HAS EROSION DUE TO SURFACE RUNOFF
Rock Slope Protection - Riprap Failures	RIPRAP IS MISSING ALONG TOE OF DOWNSTREAM SLOPE
Unusual Movement or Cracking at or near Toes	NONE
Unusual Embankment or Downstream Seepage	POOL OF ORANGE STAINED WATER ON WEST SIDE OF DISCHARGE STRUCTURE. ON EAST SIDE, APPEARS TO BE REMAINS OF CONDUIT.
Piping or Boils	NONE
Foundation Drainage Features	NONE
Toe Drains	UNKNOWN
Instrumentation System	NONE

PERIODIC INSPECTION CHECK LIST

PROJECT Harlow Brook Dam No. 1 DATE 12/11/78

PROJECT FEATURE Outlet Structure NAME Michael Gilbert

DISCIPLINE Geotechnical NAME Richard Weber

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	The upstream slope is all rock fill. The concrete structure None - extends only ~4ft. from crest.
Slope Conditions	NA (not applicable)
Bottom Conditions	Rock Fill - good condition
Rock Slides or Falls	NA
Log Boom	None
Debris	Clear
Condition of Concrete Lining	Fair
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Fair
Stop Logs and Slots	Some leakage through stop logs, manually installed but appears that it would be difficult to do so.

PERIODIC INSPECTION CHECK LIST

PROJECT Harlow Brook Dam No. 1 DATE 12/11/78

PROJECT FEATURE Conduit NAME Michael Gilbert

DISCIPLINE Geotechnical NAME Richard Weber

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Arched concrete conduit 5'x10' ht.
General Condition of Concrete	Poor - spalling
Rust or Staining on Concrete	Yes - horizontal crack the entire length. Staining on conc. at waterline
Spalling	Yes - area on west wall approximately 10 sq. ft. extensive - Rebar is exposed
Erosion or Cavitation	Approximately 1 ft upstream of spalled area wall is undermined 1.6 ft.
Cracking	West wall has horizontal crack the entire length.
Alignment of Monoliths	NA
Alignment of Joints	NA
Numbering of Monoliths	NA

* There also appears to be seepage coming through the concrete wall in this exposed area.

PERIODIC INSPECTION CHECK LIST

PROJECT Harlow Brook Dam No. 1 DATE 12/11/78

PROJECT FEATURE Outlet Structure NAME Michael Gilbert

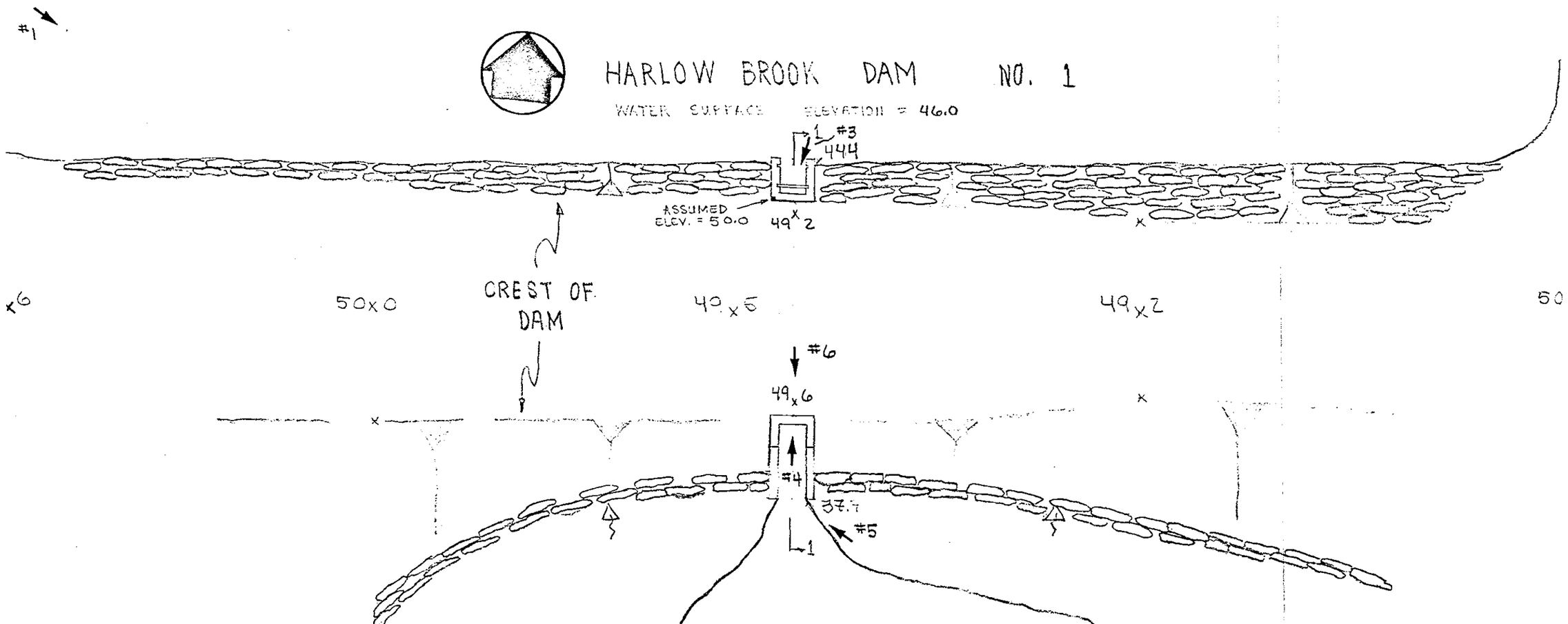
DISCIPLINE Geotechnical NAME Richard Weber

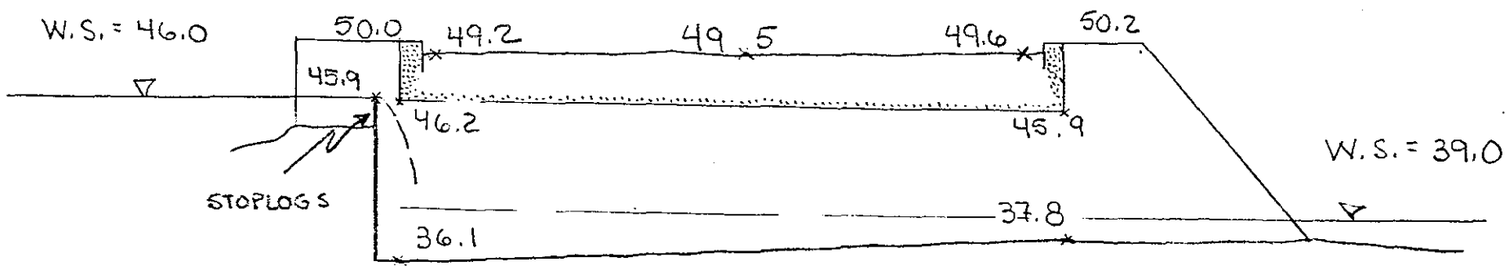
AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Poor
Rust or Staining	Staining at bottom, near water level
Spalling	Extensive on the verticle sloped walls
Erosion or Cavitation	Extensive erosion on slope near the walls, and undermining of the walls
Visible Reinforcing	No
Any Seepage or Efflorescence	Little efflorescence
Condition at Joints	Fair
Drain Holes	None
Channel	Hand placed rock. Some rock is missing.
Loose Rock or Trees Overhanging Channel	No
Condition of Discharge Channel	Cluttered with debris

APPENDIX B

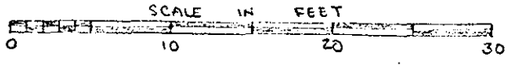
PLANS OF DAMS AND PREVIOUS
INSPECTION REPORTS

HARLOW BROOK DAM NO. 1





SECTION 1-1
DISCHARGE CONDUIT



NOTE:

1. ELEVATIONS SHOWN ARE REFERENCED TO ASSUMED BENCHMARK ELEV. 50.0 ON WING WALL
2. INFORMATION SHOWN BASED ON FIELD SURVEY OF DECEMBER 11, 1978.
3. ⚓ DENOTES SEEPAGE
4. #2 INDICATES LOCATION AND DIRECTION OF VIEW FOR PHOTOGRAPHS

METCALF & EDDY, INC. ENGINEERS BOSTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
HARLOW BROOK DAM NO. 1	
FIGURE B-1 PLAN OF DAM AND SECTIONS	
TRIBUTARY WAREHAM RIVER	MASSACHUSETTS
SCALE: AS SHOWN	DATE: MARCH, 1979

METCALF & EDDY, INC.

DAM NO. 220

COUNTY OF PLYMOUTH, MASSACHUSETTS

ENGINEERING DEPARTMENT

INSPECTION OF DAM AND RESERVOIRS

Inspector Grocer & Hause Date Sept. 8 1937 City or Town Wareham

Location On Harlow Brook West of Charge Pond Road from S. West corner of N. Standish Reservation

Owner ~~United Cape Cod Cranberry Co.~~ Gurney Bogs Use Reservoir for Bogs.

Material and Type Sand & Earth Fill with Concrete Spillway

Maximum Head in Feet (Full Pond Level to Bottom of Spillway) 12 feet

Length 200 feet Width 40 feet

Area of Watershed 1½ Sq. Miles Capacity 35,000,000 Gallons

Length of Overflow or Spillway 5'-2" Outlets (Pipes or Flumes)

Dam Constructed by Date 1910

Recent Repairs Date

Evidence of Leakage Some seepage

Condition Good

Topography of Country Below Flat country & Cranberry bogs below reservoir

Nature, extent, proximity, etc. of buildings, roads or other property in danger if failure should occur

If this dam should fail it would damage owners bogs only.

No buildings near.

Remarks and Recommendations

Area of spillway ample with proper supervision

This reservoir is on Harlow Brook.

Unchanged - January 1939. Unchanged Dec. 1941. Unchanged April 1, 1943.

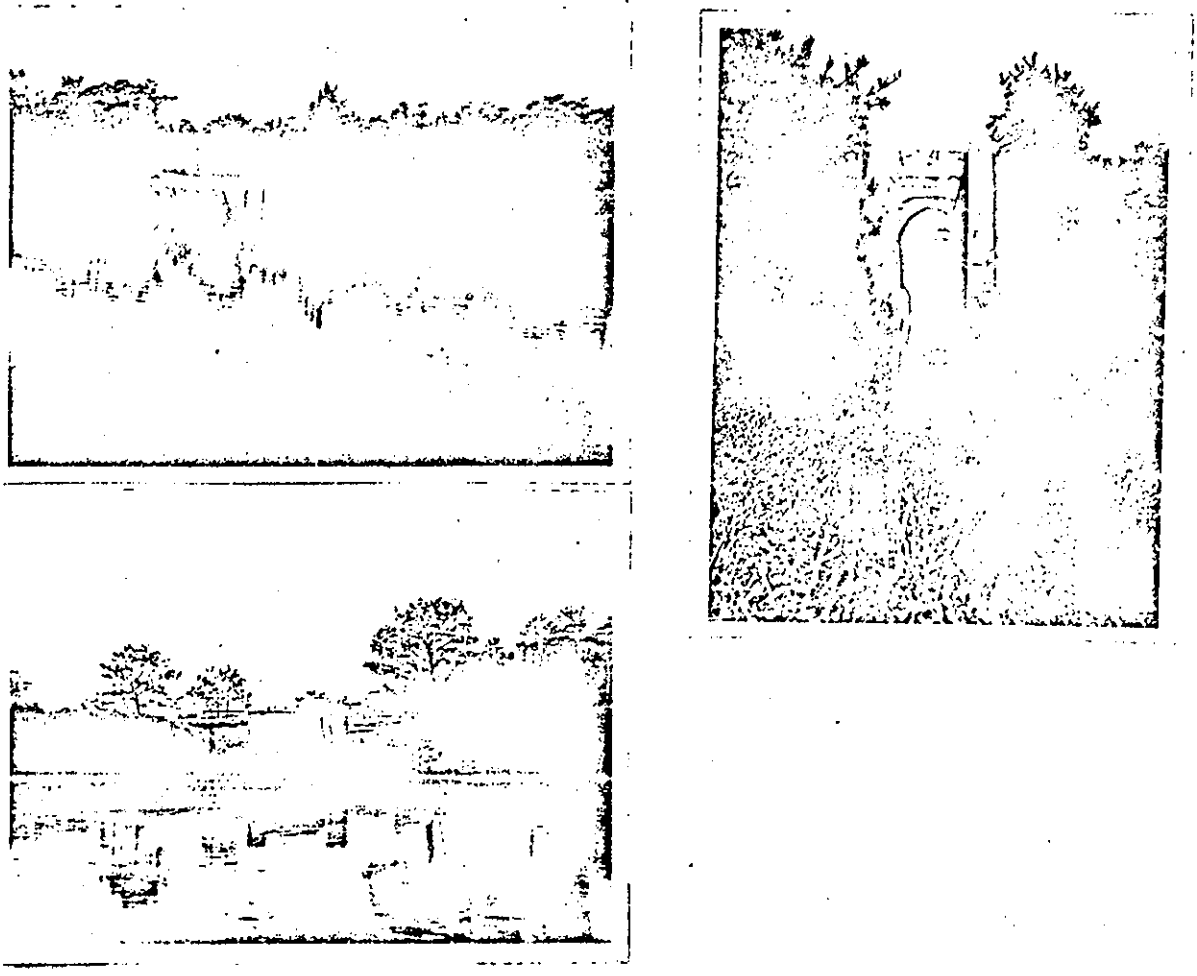
No changes - sound Nov. 1944. No change - sound Sept. 1951. Unchanged sound Nov. 1953.

Good - unchanged Nov. 1955. Good - no changes June 1957. Sound - no changes Sept. 1959.

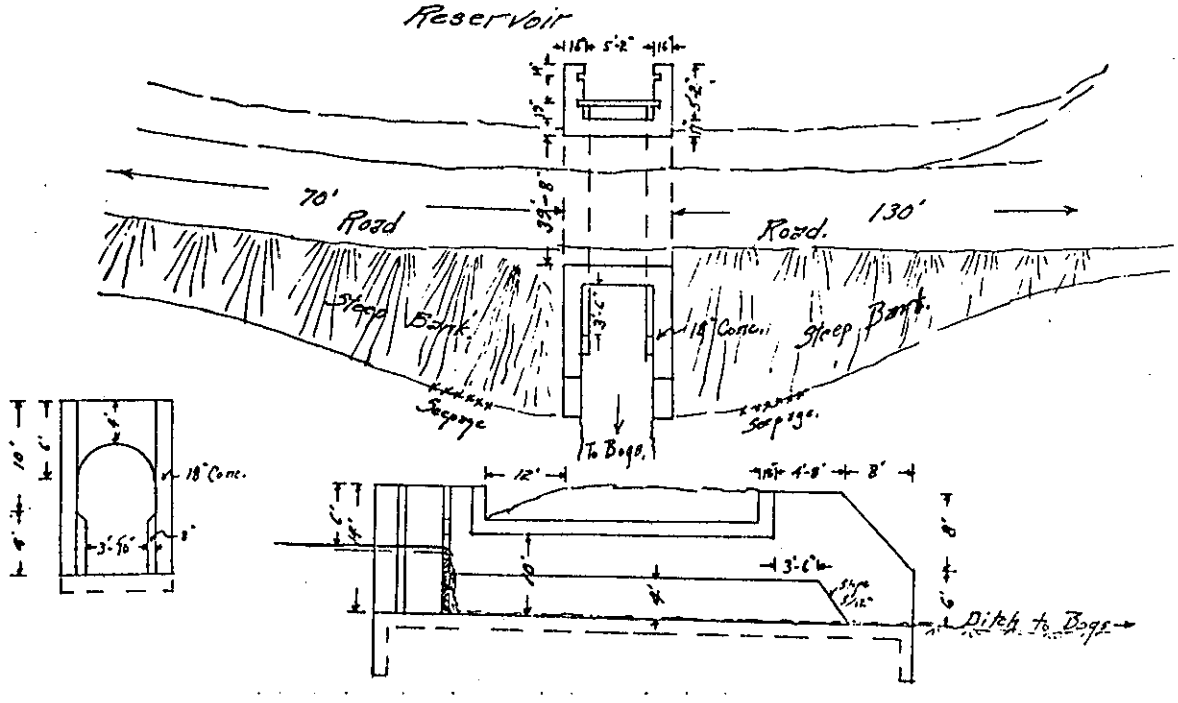
Sound - unchanged Sept. 1961. Good - no change Dec. 1963. Good - Exit wings scoured (Weed fill at spillway)

Dec. 1965. Good - no change Nov. 1967. Good - Conc. wings at outlet hanging Oct. 1969.

DAM NO 2 & 3



Sketch of Dam (not to Scale)



October 19, 1973

Pine Grove Terrace Inc.
601 Main Street
Malden, Massachusetts

Re: Inspection-Dam #7-12-310-10
Wareham
Harlow Brook #1 Dam

Gentlemen:

An engineer from the Massachusetts Department of Public Works has inspected the above dam, of which Pine Grove Terrace Inc. is the owner.

The inspection was made in accordance with Chapter 253 of the Massachusetts General Laws, as amended by Chapter 595 of the Acts of 1970.

The results of the inspection indicate that this dam is safe; however, the following conditions were noted that require attention:

1. Seepage was noted on the downstream face of the dam. This should be investigated and corrected as necessary.

2. The downstream slope shows evidence of considerable erosion. These areas should be regraded using suitable material properly compacted. It has been recommended that these slopes be flatter.

3. Various degrees of concrete deterioration exists at the spillway. Repair or replace as needed.

We call these conditions to your attention now, before they become serious and more expensive to corrected.

Very truly yours,

F.C. Schwelm

FRED. C. SCHWELM, P.E.
Deputy Chief Engineer

LRQ
LRQ:wrm
c.c. R.J. Kelleher DIST#7
J. Delano Dist.#7

New topo Sheet needed!!
New Zerox of Updated Sketch

7-226

INSPECTION REPORT - DAMS AND RESERVOIRS

. Location: ~~City~~/Town WAREHAM Dam No. 7-12-310-10

Name of Dam HARLOW BROOK (#1 R.) Inspected by: K.B. HARRISON & G. BUMPUS JOHN DELANO & J. McGARRY

Date of Inspection ~~8-14-73~~ 9-21-73

. Owner/s: Per: Assessors ✓ Prev. Inspection 3-23-71

Reg. of Deeds _____ Pers. Contact _____

1. ~~C.V.P. CRANBERRY CO. MAIN ST. WAREHAM MASS~~ PINE GROVE TERRACE, INC., 661 MAIN ST., MALDEN, MASS.

Name	St.& No.	City/Town	State	Tel.No.

Name	St.& No.	City/Town	State	Tel.No.

Name	St.& No.	City/Town	State	Tel.No.

. Caretaker: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name	St.& No.	City/Town	State	Tel.No.
Carlo Pena etc.	28 B W. Falmouth		Mass.	

. No. of Pictures taken NONE

. Degree of Hazard: (if dam should fail completely)*

1. Minor ✓ 2. Moderate _____

3. Severe _____ 4. Disastrous _____

*This rating may change as land use changes (future development)

. Outlet Control: Automatic _____ Manual ✓

Operative ✓ yes; _____ No

Comments: FLASH BOARDS

. Upstream Face of Dam: Condition:

Conditions:

1. Good ~~✓~~ 2. Minor Repairs ✓

3. Major Repairs _____ 4. Urgent Repairs _____

Comments: Slopes should be flattened

Dam No. 7-12-310-10

8. Downstream Face of Dam:
Condition: 1. Good ~~✓~~ 2. Minor Repairs ✓
3. Major Repairs _____ 4. Urgent Repairs _____
Comments: Slopes should be flattened
Evidence of Seepage.

9. Emergency Spillway:
Condition: 1. Good _____ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Repairs _____
Comments: NONE

10. Water Level at Time of Inspection:
3.5 ft. above _____. below ✓. top of dam _____
principal spillway ✓. other _____.

11. Summary of Deficiencies Noted:
Growth (Trees & Brush) on Embankment NO
Animal Burrows & Washouts NO
Damage to Slopes or Top of Dam ~~NO~~ Considerable Erosion
Cracked or Damaged Masonry ~~NO~~ some cracking & spalling of spillway
Evidence of Seepage ~~NO~~ Yes
Evidence of Piping NO
Erosion ~~NO~~ Yes
Leaks NO
Trash and/or Debris Impeding Flow NO
Clogged or Blocked Spillway NO
Other

12. Remarks & Recommendations: (Fully Explain)

~~Dam is in good overall condition.~~

Some seepage evident on downstream faces.

Both Upstream & Downstream slopes should be flattened with suitable impervious material so as to discourage seepage. This operation is also necessary to repair considerable erosion from a recent rainstorm.

The concrete on the inside faces of the spillway (downstream end) is cracked & shows signs of spalling. These areas should be properly patched. There is also a large area (approx. 3' square) on the Wly. inside wall of the conc. spillway which has spalled to nearly the full thickness of the conc. This area should be properly patched.

13. Overall Condition:

1. Safe ✓
2. Minor Repairs Needed ✓
3. Conditionally Safe - Major Repairs Needed
4. Unsafe
5. Reservoir Impoundment no Longer Exists (explain)

Recommend Removal from Inspection List

DESCRIPTION OF DAM

DISTRICT 7

omitted by JOHN DELANO Dam No. 7-12-310-10

e 8-15-73 ~~City~~/Town WAREHAM

Name of Dam HARLOW BROOK ~~DAM~~ #1

Location: Topo Sheet No. 45C

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

Year Built 1910 Year/s of Subsequent Repairs

Purpose of Dam: Water Supply Recreational

Irrigation ✓ Other

Drainage Area: 1.5 Sq.Mi. Acres

Normal Ponding Area: Acres Ave.Depth

Impoundment: ~~35,000,000~~ 50,000,000 Gals. Acre Ft.

No. and Type of Dwellings Located Adjacent to Pond or Reservoir

i.e. Summer Homes, etc. NONE

Dimensions of Dam: Length 200 FT. Max. Height 12 FT.

Slopes: Upstream Face VERT.

Downstream Face 5 FT.

Width Across Top 35 FT.

Classification of Dam by Material:

Earth ✓ Conc. Masonry Stone Mason.

Timber Rockfill Other

DAM NO. 7-12-310-10

9.

A. Description of Present Land Usage Downstream of Dam:

100 % rural _____ % urban

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure ✓ yes _____ no

---

10.

Risk to Life and Property in Event of Complete Failure

No. of People 0

No. of Homes 0

No. of Businesses 0

No. of Industries 1 Type CRANBERRY BOGS

No. of Utilities 0 Type _____

Railroads 0

Other Dams 7-12-310-11

Other _____

11.

Attach sketch of dam to this form showing section and plan on an 8½" x 11" sheet.

DESCRIPTION OF DAM

DISTRICT 7

Submitted by: [illegible] Dam. No. 7-12-310-10

Date 12-1-75 City/Town Winchester

Name of Dam Harlow Brook #1

1. Location: Topo Sheet No. 45C

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year Built: 1910 Year/s of Subsequent Repairs 1970's

3. Purpose of Dam: Water Supply ____ Recreational ✓

Irrigation ✓ Other ____

4. Drainage Area: 1.5 Sq. Mi. ____ Acres

5. Normal Ponding Area: ____ Acres ____ Ave. Depth

Impoundment: 50,000,000 Gals. ____ Acre Ft.

6. No. and Type of Dwellings Located Adjacent to Pond or Reservoir

i.e. Summer Homes, etc. None.

7. Dimensions of Dam: Length 210' Max. Height 14'

Slopes: Upstream Face Varies 6'-12' wide

Downstream Face " 12' "

Width Across Top 35'+

8. Classification of Dam by Material:

Earth ✓ Conc. Masonry ____ Stone Masonry ____

Timber ____ Rockfill ✓ Other ____

9. A. Description of Present Land Usage Downstream of Dam:

100 % Rural ____ % Urban

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure

✓ Yes ____ No

Dam No. 7-12-310-10

10. Risk to Life and Property in Event of Complete Failure

No. of People 0

No. of Homes 0

No. of Businesses 0

No. of Industries 1 Type Saw Mill

No. of Utilities 0 Type

Railroads 0

Other Dams 7-12-310-11

Other

11. Attach sketch of dam to this form showing section and plan on an 8½" x 11" sheet.

Make revised sketch

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: ~~City~~/Town Wareham. Dam No. 7-12-310-10

   Name of Dam Harlow Brook #1 Inspected by: K.O.Y.

   Date of Inspection: 10-10-75

2. Owner/s: Per: Assessors ✓ Prev. Inspection 9-21-73

   Reg. of Deeds ____ Pers. Contact ____

   1. Pine Grove Terrace Inc. 661 Main St. Malden Mass.

Name	St. & No.	City/Town	State	Tel. No.
Name	St. & No.	City/Town	State	Tel. No.
Name	St. & No.	City/Town	State	Tel. No.

3. Caretaker: (if any) e.g. superintendent, plant manager appointed by, absentee owner, appointed by multi-owners.

   Carlo Pena Rte 23A West Falmouth Mass.

Name	St. & No.	City/Town	State	Tel. No.

4. No. of Pictures taken: None.

5. Degree of Hazard: (if dam should fail completely)*

   1. Minor ✓ 2. Moderate ____

   3. Severe ____ 4. Disastrous ____

   *This rating may change as land use changes (future development)

6. Outlet Control: Automatic ____ Manual ✓

   Operative: Yes ✓ No ____

   Comments: Large Conc flume w/ [illegible] [illegible] [illegible] [illegible], [illegible] [illegible].

7. Upstream Face of Dam:

   Conditions:

   1. Good ✓ 2. Minor Repairs ____

   3. Major Repairs ____ 4. Urgent Repairs ____

   Comments: ____

Dam No. 7-12-310-10

8. Downstream Face of Dam:

Conditions:

1. Good ✓ 2. Minor Repairs _____

3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

9. Emergency Spillway: None.

Conditions:

1. Good _____ 2. Minor Repairs _____

3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

10. Water Level at Time of Inspection:

4.1 ft. _____ above ✓ below top of dam.

✓ principal spillway _____ other

11. Summary of Deficiencies Noted:

Growth (Trees & Brush) on Embankment No

Animal Burrows & Washouts No

Damage to Slopes or Top of Dam No

Cracked or Damaged Masonry Yes

Evidence of Seepage No

Evidence of Piping No

Erosion No

Leaks No

Trash and/or Debris Impeding Flow No

Clogged or Blocked Spillway No

Other _____

Dam No. 7-12-310-10

12. Remarks & Recommendations (fully explain)

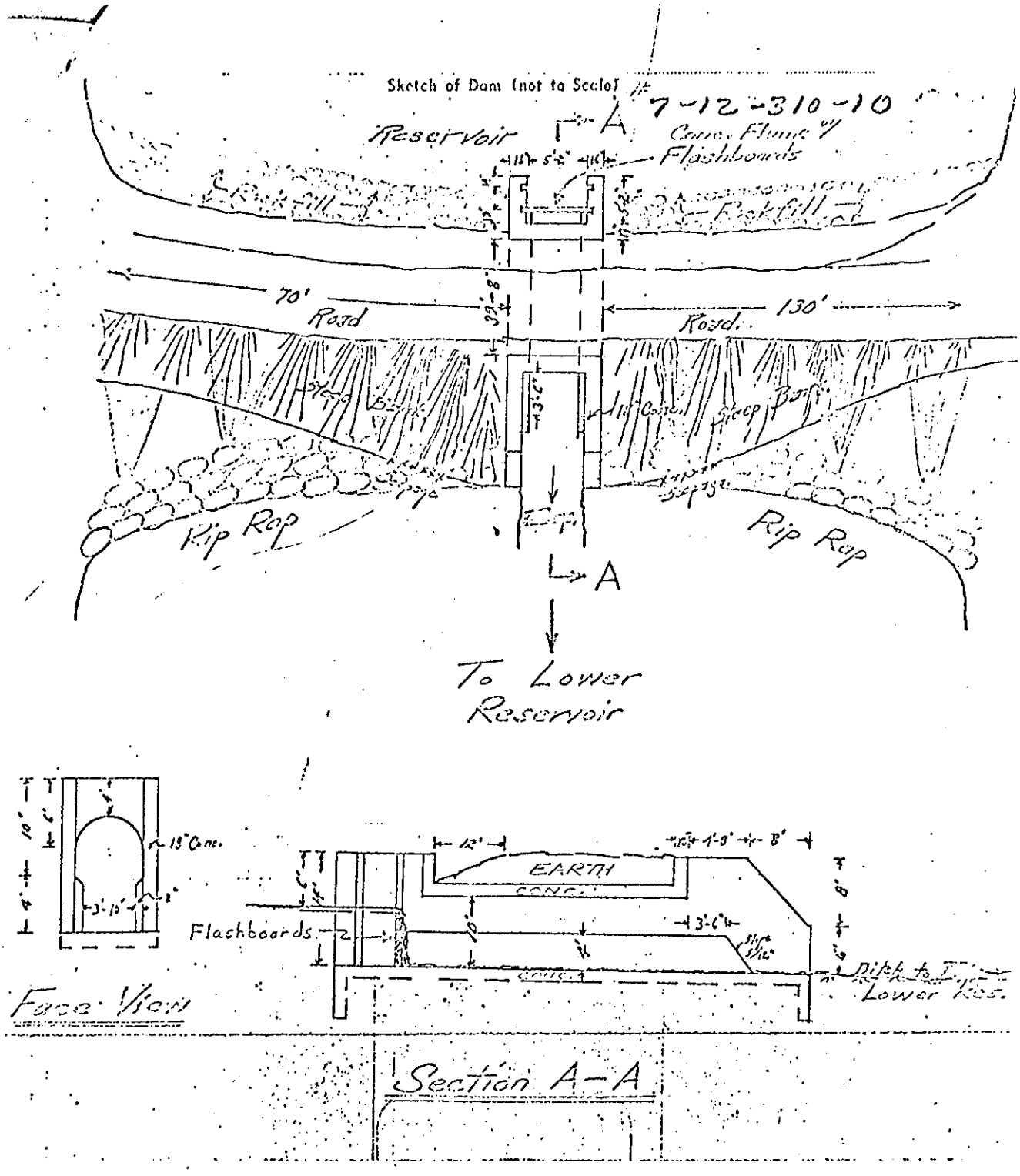
This dam is now in good general condition. The upstream slope has been flattened & lined with rock fill and the downstream slope has also been flattened & lined with riprap. Both slopes show the stone work have a good growth of grass. The only deficiency previously reported that has not been corrected is the deteriorated zone in the spillway which has not been patched. This should be done. See revised data ([illegible]) which shows the improvements.

13. Overall Condition:

1. Safe ✓
2. Minor Repairs Needed ✓
3. Conditionally Safe - Major Repairs Needed __________
4. Unsafe __________
5. Reservoir Impoundment no Longer Exists (explain)

   Recommend Removal from Inspection List __________

HARLOW BROOK DAM NO.1



Revised Sketch
As of 11-10-75

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Waterways
100 Nashua Street, Boston 02114

May 22, 1978

Pine Grove Terrace, Inc.
661 Main Street
Malden, MA

Re: Inspection - Dam #7-12-310-10
Wareham
Hollow Brook Dam #1

Gentlemen:

An inspection was made of the above-named dam on February 28, 1978. Our records show the owner to be Pine Grove Terrace, Inc. If this information is incorrect, please notify this office. With any correspondence relative to this dam, please include the number as shown.

We recommend that you correct the following conditions before they become serious and more costly.

1. Leakage through flashboards.
2. Deterioration to concrete - extreme downstream end of the walls from the water level to the bottom of flume.

Very truly yours,

JOHN J. HANNON, P.E.
Chief Engineer

cc: Department of Public Works
District No. 7

MAP:fns

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town Braintree Dam No. 7-12-310-10

Name of Dam Hollow Brook No# 1 Inspected by: R.H.S.

Date of Inspection: 28 Feb. 78

2. Owner/s: Per: Assessors _____ Prev. Inspection ✓ (As of 10-10-75

Reg. of Deeds _____ Pers. Contact _____

	Name	St. & No.	City/Town	State	Tel. No.
1.	Pine Grove Terrace Inc.	661 Main St.	Malden	Mass.	

3. Caretaker: (if any) e.g. superintendent, plant manager appointed by absentee owner, appointed by multi-owners.

Name	St. & No.	City/Town	State	Tel. No.
Carlo Pena	Rte # 28A	West Falmouth	Mass.	

4. No. of Pictures taken: None

5. Degree of Hazard: (if dam should fail completely)*

1. Minor ✓ 2. Moderate _____

3. Severe _____ 4. Disastrous _____

*This rating may change as land use changes (future development)

6. Outlet Control: Automatic _____ Manual ✓

Operative: Yes ✓ No _____

Comments: Lc. Conc. Flume w/ Flashboards & Conc Pipe Culvert Type Spillway.

7. Upstream Face of Dam:

Conditions:

1. Good ✓ 2. Minor Repairs _____

3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

Dam No. 7-12-310-10

8. Downstream Face of Dam:

Conditions:

1. Good ✓ 2. Minor Repairs ✓

3. Major Repairs ____ 4. Urgent Repairs ____

Comments: Some Deterioration Noted To Flume Walls. At Bottom of Same.

9. Emergency Spillway: None

Conditions:

1. Good ____ 2. Minor Repairs ____

3. Major Repairs ____ 4. Urgent Repairs ____

Comments: ____

10. Water Level at Time of Inspection:

3.2 ft. ____ above ✓ below top of dam.

✓ principal spillway ____ other

11. Summary of Deficiencies Noted:

Growth (Trees & Brush) on Embankment No

Animal Burrows & Washouts No

Damage to Slopes or Top of Dam No

Cracked or Damaged Masonry Yes

Evidence of Seepage No

Evidence of Piping No

Erosion No

Leaks Thru Flashboards

Trash and/or Debris Impeding Flow No

Clogged or Blocked Spillway No

Other ____

Dam No. 7-12-310-10

12. Remarks & Recommendations (fully explain)

See Report of 10-10-75
Dike Has Good Height & Excellent Width.
Some Leakage Noted Thru Flash Boards No
Flow Over F/Boards. Deterioration To Conc.
Is At Bottom At Extreme Down Stream End
of Walls. — Water Level To Bottom of Flume
± One Foot.

13. Overall Condition:

1. Safe ✓
2. Minor Repairs Needed ✓
3. Conditionally Safe - Major Repairs Needed
4. Unsafe
5. Reservoir Impoundment no Longer Exists (explain)

   Recommend Removal from Inspection List

APPENDIX C

PHOTOGRAPHS

HARLOW BROOK NO. 1

NO. 1 UPSTREAM SLOPE OF DAM

NO. 2 DOWNSTREAM SLOPE AND OUTLET STRUCTURE

NO. 3 STOPLOGS AT INLET STRUCTURE

NO. 4 DISCHARGE CONDUIT

NO. 5 DISCHARGE CHANNEL AT OUTLET STRUCTURE

NO. 6 VIEW DOWNSTREAM FROM DAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

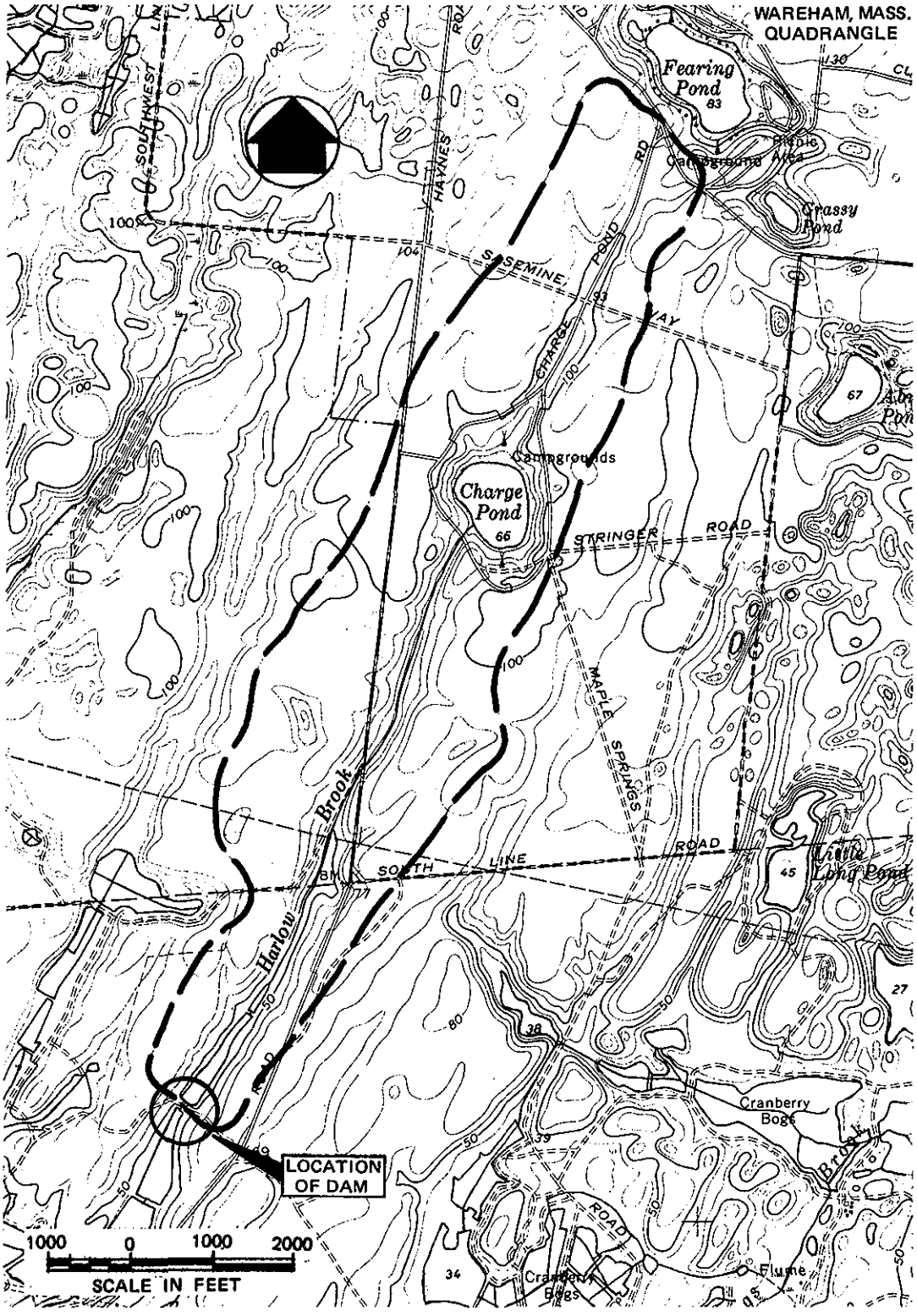


FIG. D-1 DRAINAGE AREA MAP – HARLOW BROOK

(I) Test Flood, Storage & Storage Functions

1- Total Drainage Area = 1.06 mi²

2- Pond(s) Area: .006 + .025 = .031
Sinkhole Area: .027 + .017 = .044
Total Area Pond(s) & Swamp(s): .075

% Ponds & Swamps = $\frac{.075}{1.06}$ = 7.1%

3- $\frac{125-45}{13500}$ = .0059 } Say Ave Slope = 0.6%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be slightly above "Flat & Coastal" and taken at 1050 c.f.s./mi²
Size Class: Small ; Hazard Pot.: Low ; Spill. Des. Flood: 50 to 100yr freq.
Use: Test Flood = 100yr freq. ≃ ¼ P.M.F.

5- **Test Flood Inflow = $\frac{1}{4}$ (1050) 1.06 = 280 c.f.s.**

6- Pond Storage
The pond area is .0064 sq. mi. at elev. 46.0.
Based on a const. area, storage increases at 4.13 ac. feet per foot of depth increase.

7- Spillway crest elev. is 45.9' (Top of exist. stoplogs)

8- Storage Functions are based on $Q_{out} = Q_{in}\left[1 - \frac{S_{out}}{R}\right]$

S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

S(in Inches) = $12 D \left(\frac{.006}{1.06}\right)$ = .068 D ; R = 6hr rain of Storm

D = Storage depth in feet above spillway crest in reservoir

9- Storage Functions: (Test Flood & ½ PMF - if needed)

F_{TF} = 280 − 59	$S = 280 - 4.0\,D$
$F_{½PMF}$ = 560 − 59	$S = 560 - 4.0\,D$

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(II) Discharge Ratings

A - Spillway - as weir

Crest Stoplogs @ El. 45.9, Width 5 ft

Use Williams & Hazen "Hydr. Tables" with $p = 30$ & no side contr.

Pond Elev.	47	48	49	50	51	52
Q_A	20	50	90	140	190	250

B - Spillway - as orifice

For depths over 3' to 4', opening below stoplogs would choke and act as orifice. Area = 5' x 1.6' = 8 ft², $C_o \simeq 0.61$

$Q_B = 0.61\,(8)\sqrt{2gH_B} = 39.16\,H_B^{1/2}$

Pond Elev	49	50	51	52
Q_B	70	80	90	100

Note: Movement of Stoplog to upstr. slot would eliminate "choke".

C - Over Crest Flow

Use broad crest flow relation $\simeq q = 2.55\,H_c^{1.5}$
Ref: V.T. Chow, "Open Channel Hydr." pg 52, 53

Q_1: 140' @ El. 49.5 ±; Q_2: 80' @ El. 50 ±; Q_3: 50' @ El. 50.5 ±

Pond El.	50	51
Q_1	130	660
Q_2	—	200
Q_3	—	40
ΣQ_c	130	900

D. Pond Drawdown

Remove 12" of stoplogs w/ pond @ El. 459; $Q_{out} = 16.65$ cfs (Same as "A")

Time to drawdown 1 foot $= \dfrac{(4.13)43560}{16.65(\frac{1}{2})3600} = 6.0$ hours

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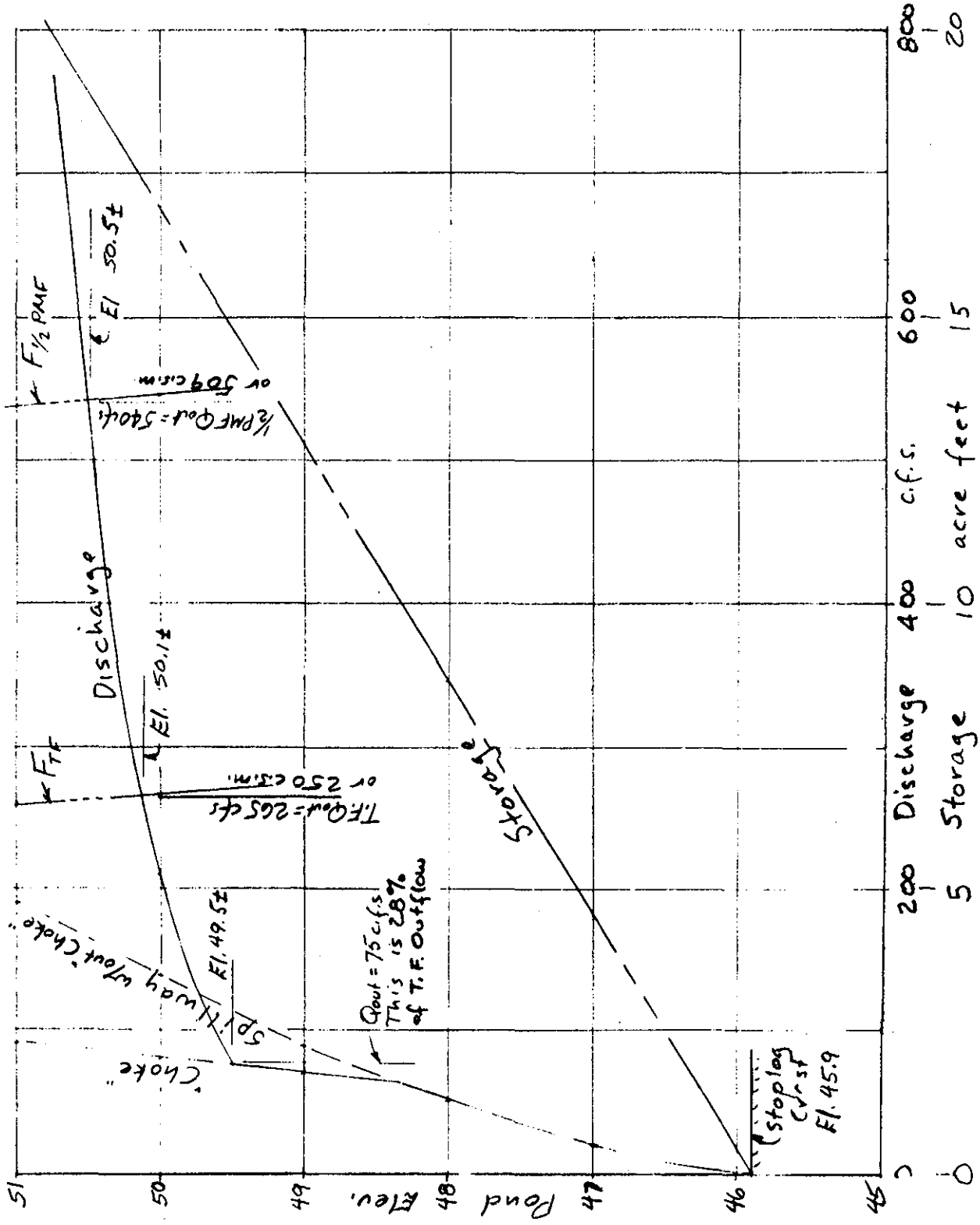
Project	Nat. Review of Non Fed. Dams	Acct. No.	6191	Page	3 of 5
Subject	Plymouth County, Mass.	Comptd. By	LEB	Date	1/16/79
Detail	HARLOW BROOK DAM (No. 1)	Ck'd. By	MJB	Date	1/19/79

(III) Discharge, Storage & Storage Function vs Pond Elev.



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(IV) Crest Flow Characteristics

Max Hd: 50.1 - 47.2 = 0.9' (49.2 at local low pt.)

$q = 2.55 (.9)^{1.5} = 2.18$ cfs/ft

As "Critical" Flow

$y_c = 0.53'$, $V_c = 4.13$ fps

(V) Failure of Dam

Peak Failure Flow:

Pond Elevation - 49.5 (Nom. Z.R. Dam Crest)
Toe Elevation — 37.7
Y_o = 11.8

Dam Length Subject to Breaching = 120' (East End)

$W_o = 40\%(120) = 48$

$$Q_{P_1} = 1.68\, W_o (Y_o)^{1.5} = 1.68(48)(11.8)^{1.5} = 3300 \text{ c.f.s}$$

Q_{out} w/Pond El. 49.5 = 75 cfs.

Storage Volume Released:

Storage Above Spillway	3.6'(4.13)	= 15
Storage Below Spillway	$\frac{1}{3}(8.2)\,4.13$	= 11
S = Total Storage =		26

Channel Hydraulics:

There is no downstream channel. Harlow Brook Dam - No.1 discharge directly into the upstream end of another larger pond (area ± 6.6 acres), which in turn discharges into another possibly larger pond.

The 1st down stream pond would be raised by about 4 feet if all storage was released by Harlow Brook Dam - No.1

Time to Drain:

$$\frac{43560\,(26)}{3600(\frac{1}{2})(3300)} = 0.19 \text{ Hours. or } 11 \text{ Minutes}$$

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APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS